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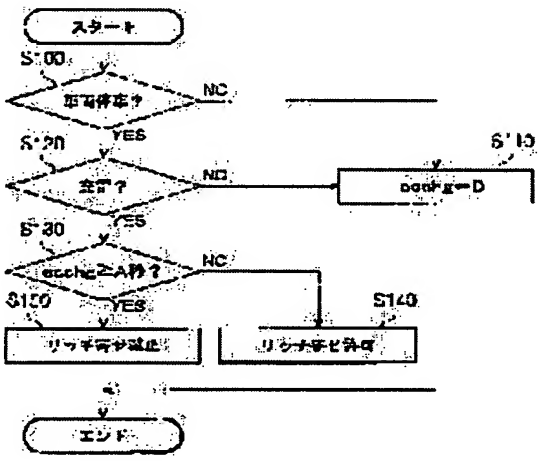
(54) AIR-FUEL RATIO CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:

PROBLEM TO BE SOLVED: To enable air-fuel ratio control which can make compatible both the reduction of NOx and the prevention of the generation of catalyst exhaust smell.

SOLUTION: At the load operation of an engine for charging a battery during stopping, a target air-fuel ratio is made nearer to a rich side than a stoichiometric air-fuel ratio thereby carrying out the air-fuel ratio control (step S140), whereby an oxygen amount in a three-way catalyst is changed so as to be far from the generation condition of NOx, and the NOx in exhaust gas is reduced. Together with this, by carrying out the air-fuel control for a predetermined time of A second from a charge starting time (steps S130, S150), the generation of the catalyst exhaust smell due to the exhaustion of oxygen in the three-way catalyst can be prevented. Accordingly, in charging of the battery during stopping, the air-fuel ratio control which can make compatible both the reduction of NOx and the prevention of the generation of the catalyst exhaust smell is realized.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The air-fuel ratio control system of the internal combustion engine characterized by having an Air Fuel Ratio Control means to bring near predetermined time and a target air-fuel ratio by the rich side from theoretical air fuel ratio from the time of initiation of this load operation, and to perform Air Fuel Ratio Control in the air-fuel ratio control system of the internal combustion engine having an internal combustion engine and two sources of power of a motor, and the dc-battery that supplies power to this motor when carrying out load operation of said internal combustion engine during a stop.
[Claim 2] Said Air Fuel Ratio Control means is the air-fuel ratio control system of the internal combustion engine according to claim 1 characterized by performing said Air Fuel Ratio Control when carrying out load operation of said internal combustion engine, in order to charge said dc-battery during a stop.
[Claim 3] Said Air Fuel Ratio Control means is the air-fuel ratio control system of the internal combustion engine according to claim 1 or 2 characterized by setting it as the value which brought near said target air-fuel ratio by the rich side more greatly, so that there were many amounts of oxygen within a catalyst, and performing said Air Fuel Ratio Control.
[Claim 4] Said Air Fuel Ratio Control means is the air-fuel ratio control system of the internal combustion engine according to claim 1 or 2 characterized by setting said predetermined time as a larger value, and performing said Air Fuel Ratio Control, so that there are many amounts of oxygen within a catalyst.
[Claim 5] Said Air Fuel Ratio Control means is the air-fuel ratio control system of an internal combustion engine given in any 1 term of claims 1-4 which drive said internal combustion engine in a idle state during said stop, and are characterized by performing said Air Fuel Ratio Control when carrying out load operation.
[Claim 6] Said Air Fuel Ratio Control means is the air-fuel ratio control system of an internal combustion engine given in any 1 term of claims 1-4 characterized by performing said Air Fuel Ratio Control when carrying out load operation of said internal combustion engine which is in idle operational status during a stop.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] this invention -- an internal combustion engine's air-fuel ratio control system -- it is related with the air-fuel ratio control system of the internal combustion engine of a hybrid car in detail.
[0002]
[Description of the Prior Art] In recent years, two sources of power, an internal combustion engine and a motor, are carried, and the hybrid car which switched those sources of power suitably according to the run state etc. is proposed. At the time of high-speed transit, it runs with an internal combustion engine, it is such a hybrid car at the low-speed transit time, and when an engine load is small, at the time of un-driving [of an air conditioner] etc. runs with a motor. Moreover, it is at the low-speed transit time, and when an engine load is large, it runs with a motor and an internal combustion engine at the time of the drive of an air conditioner etc. Moreover, although an internal combustion engine is usually automatically suspended at the time of a stop, even if it is under stop, when charge of a dc-battery is required, or when the air conditioner is driving, an internal combustion engine drives. However, by such intermittent engine halt, oxygen will be stored in the catalyst prepared in the flueway, and NOx in exhaust gas will increase. Based on the output of O2 sensor, general technique carries out feedback control of the fuel oil consumption so that it may become the target air-fuel ratio to which the target air-fuel ratio was set a little to the rich side from theoretical air fuel ratio, and the engine air-fuel ratio was set as the cure. Hereafter, this feedback control of air-fuel ratio is called "Air Fuel Ratio Control" for short.
[0003]
[Problem(s) to be Solved by the Invention] By the way, as mentioned above, in order to charge a dc-battery, when a generator is driven with an internal combustion engine during a stop, a load comparable as the time of 20 km/h transit may be applied to an internal combustion engine. Thus, when Air Fuel Ratio Control at the time of carrying out load operation of the internal combustion engine for dc-battery charge during a stop is performed with the target air-fuel ratio brought near by the rich side too much, it changes to an amount's of oxygen within catalyst exhaustion side as the rebellion, and there is a possibility that a catalyst exhaust air smell may occur. This is because NOx will occur if the oxygen within a catalyst is saturated, and a catalyst exhaust air smell will occur if the oxygen within a catalyst is conversely drained. In this way, if Air Fuel Ratio Control under stop is performed with the target air-fuel ratio brought near by the rich side too much in order to make NOx in exhaust gas below into a regulation value, NOx will decrease. However, a catalyst exhaust air smell will occur as the rebellion. In addition, although it is sensitive, even if NOx occurs shortly after the oxygen within a catalyst is saturated, a catalyst exhaust air smell is also a part depending on olfaction and the oxygen is drained to the saturation, it is not immediately detected (it is insensible).
[0004] Moreover, O2 sensor formed in the downstream of a catalyst detects the amount of oxygen within a catalyst as a conventional technique, and what controls Air Fuel Ratio Control to rich/Lean based on this detected amount of oxygen is known. However, with this conventional technique, as mentioned above, when an internal combustion engine is suspended intermittently, the amount of oxygen within a catalyst changes with conditions before that halt. It is difficult for the reason that amount of oxygen is correctly undetectable to perform Air Fuel Ratio Control with which reduction

of NOx and generating prevention of a catalyst exhaust air smell are compatible this reason and immediately after starting.
[0005] This invention was made paying attention to such a conventional trouble, and the purpose is in offering the air-fuel ratio control system of the internal combustion engine which made possible Air Fuel Ratio Control with which reduction of NOx and generating prevention of a catalyst exhaust air smell are compatible.
[0006]
[Means for Solving the Problem] Hereafter, the means and its operation effectiveness for attaining the above-mentioned purpose are indicated. In the air-fuel ratio control system of the internal combustion engine having an internal combustion engine and two sources of power of a motor, and the dc-battery that supplies power to this motor, invention concerning claim 1 makes it a summary to have an Air Fuel Ratio Control means to bring near predetermined time and a target air-fuel ratio by the rich side from theoretical air fuel ratio from the time of initiation of this load operation, and to perform Air Fuel Ratio Control, when carrying out load operation of said internal combustion engine during a stop.
[0007] Since it changes to the side [exhaustion /, i.e., keep away from the generating conditions of NOx, / in which / the amount of oxygen within a catalyst] by bringing near a target air-fuel ratio by the rich side from theoretical air fuel ratio, and performing Air Fuel Ratio Control by this configuration, when carrying out load operation of the internal combustion engine during a stop, NOx in exhaust gas is reduced. It can prevent that the oxygen within a catalyst is drained and a catalyst exhaust air smell occurs with this by performing only predetermined time from the time of initiation of load operation of the Air Fuel Ratio Control. Therefore, Air Fuel Ratio Control with which reduction of NOx and generating prevention of a catalyst exhaust air smell are compatible can be performed.
[0008] In addition, operation for driving a generator, although a dc-battery is charged during a stop, and operation for driving an air conditioner during a stop are included in "load operation" said here. Moreover, the "predetermined time" said here is set as time amount to which the catalyst exhaust air smell which the amount of oxygen within a catalyst is drained, and is generated does not give crew displeasure.
[0009] In order that said Air Fuel Ratio Control means may charge said dc-battery during a stop, when invention concerning claim 2 carries out load operation of said internal combustion engine in the air-fuel ratio control system of an internal combustion engine according to claim 1, let it be a summary to perform said Air Fuel Ratio Control.
[0010] In order to charge a dc-battery during a stop, when carrying out load operation of the internal combustion engine by this configuration, Air Fuel Ratio Control with which reduction of NOx and generating prevention of a catalyst exhaust air smell are compatible can be performed.
[0011] In the air-fuel ratio control system of an internal combustion engine according to claim 1 or 2, as for invention concerning claim 3, said Air Fuel Ratio Control means makes it a summary for many amounts of oxygen within a catalyst to set said target air-fuel ratio as the value more greatly brought near by the rich side, so that there are, and to perform said Air Fuel Ratio Control.
[0012] By this configuration, the inclination which changes to a that amount's of oxygen exhaustion side becomes large, so that there are many amounts of oxygen within a catalyst. Thereby, even when there are many amounts of oxygen within a catalyst, the amount of oxygen can be early kept away from the generating conditions of NOx.
[0013] Let it be a summary to set said predetermined time as a larger value, and to perform said Air Fuel Ratio Control, so that said Air Fuel Ratio Control means has many amounts of oxygen within a catalyst in the air-fuel ratio control system of an internal combustion engine according to claim 1 or 2 as for invention concerning claim 4.
[0014] Since predetermined time which performs said Air Fuel Ratio Control is lengthened more by this configuration so that there are many amounts of oxygen within a catalyst, even when there are many amounts of oxygen within a catalyst, that amount of oxygen can be early changed to the side [exhaustion / side /, i.e., keep away from the generating conditions of NOx,].
[0015] When said Air Fuel Ratio Control means drives said internal combustion engine which is in a idle state during said stop and you carry out load operation of the invention concerning claim 5 in the

air-fuel ratio control system of an internal combustion engine given in any 1 term of claims 1-4, let it be a summary to perform said Air Fuel Ratio Control.
[0016] When charge of a dc-battery is needed during a stop, the internal combustion engine in a idle state is driven and that charge is performed by this configuration, the optimal Air Fuel Ratio Control with which reduction of NOx and generating prevention of a catalyst exhaust air smell were compatible can be realized.
[0017] Let it be a summary for invention concerning claim 6 to perform said Air Fuel Ratio Control in the air-fuel ratio control system of an internal combustion engine given in any 1 term of claims 1-4, when said Air Fuel Ratio Control means carries out load operation of said internal combustion engine which is in idle operational status during a stop.
[0018] By this configuration, charge of a dc-battery is needed during a stop, and when the internal combustion engine in idle operational status performs that charge, the optimal Air Fuel Ratio Control with which reduction of NOx and generating prevention of a catalyst exhaust air smell were compatible can be realized.
[0019]
[Embodiment of the Invention] One operation gestalt which applied the air-fuel ratio control system of the internal combustion engine concerning this invention to the hybrid car hereafter is explained based on a drawing.
[0020] Drawing 3 shows roughly the engine (internal combustion engine) and drive system of a hybrid car. Two sources of power, an engine 10 and a motor 12, and the dc-battery (Maine dc-battery) 42 which supplies power to this motor 12 are carried in the hybrid car shown in this drawing. Moreover, it is prepared in the power transfer system which tells the power of an engine 10 to a driving wheel 15, and the hybrid car is equipped with the engine speed in the infinitely variable device 20 which can be changed into a stepless story.
[0021] This infinitely variable device 20 is divided into the generator 11 which drives a motor 12 with the power which had and generated the generation-of-electrical-energy function, the path which carries out the direct drive of the driving wheel 15 for the power which an engine 10 generates, and the path which makes a generator 11 drive and generate, and is equipped with the power division device 13 which can be transmitted.
[0022] The inverter 40 is connected to the generator 11 and it may have comes to change the rotational speed of this generator 11 with the control signals inputted into this inverter 40 freely by carrying out inverter control of the generator 11.
[0023] The inverter 41 is connected also to the motor 12 and it may have comes to change the rotational speed of this motor 12 freely by carrying out inverter control of the motor 12. Moreover, an inverter 41 is connected to a generator 11 and a dc-battery 42, and a motor 12 can be driven with either [at least] the power generated with the generator 11, or the power of a dc-battery 42.
[0024] In addition, according to the run state of a car, or the remaining capacity of a dc-battery 42, a generator 11 is driven under the power of an engine 10, is generated, and charges a dc-battery 42 with this power. Moreover, the energy which the motor 12 also performed the regeneration generation of electrical energy by functioning as a generator at the time of moderation and braking etc., and collected is stored in a dc-battery 42.
[0025] The power division device 13 consists of Sun Geer connected with the generator 11, a ring gear connected with the motor 12, and an epicyclic gear which consists of a planetary carrier connected with crankshaft 10a of an engine 10. On the planetary carrier, two or more planetary gears are supported pivotable, Sun Geer and a ring gear did and each planetary gear meshes with both gears.
[0026] Thus, by the constituted infinitely variable device 20, at the "time of starting" of an engine 10, since the driving wheel 15 has stopped, it is stopped by the ring gear (a motor 12, driving wheel 15). If a generator 11 is made to rotate Sun Geer here by energizing the current stored in the dc-battery 42, an engine 10 will rotate. At this time, the generator 11 is used as a starter motor.
[0027] At ""the time of start and low-speed transit"", actuation of an engine 10 is stopped and a driving wheel 15 is driven only with the power of a motor 12. The generator 11 is raced at this time. An engine 10 operates at "usually, the time of transit", and the power is transmitted to a driving wheel 15 through the power division device 13 and a reducer 14. Moreover, the power of an engine

10 is transmitted also to a generator 11 through the power division device 13, and a generation of electrical energy is performed by this generator 11. And the power generated with the generator 11 is supplied to a motor 12, this motor 12 drives, and the driving force of an engine 10 is assisted. Moreover, at the "times of a heavy load" at the time of full open acceleration etc., the power from a dc-battery 42 is also supplied to a motor 12.

[0028] Thus, adjustment has become possible suitably according to the power division device 13 about the rotational speed of an engine 10 by controlling the inverters 40 and 41 of the infinitely variable device 20 by ECU16, and adjusting the amount of generations of electrical energy and rotational speed of a generator 11. That is, the rate of the power transfer between both paths can be suitably changed so that the actuation effectiveness of an engine 10 may consider as max.

[0029] Drive connection of the crankshaft 10a of an engine 10 is carried out at various auxiliary machinery, such as a compressor for air conditioners (illustration abbreviation), and these auxiliary machinery operates under the power of an engine 10.

[0030] The 31 air flow meter air cleaner 32 and the throttle valve 33 are formed in the inhalation-of-air path 30 of an engine 10 sequentially from the upstream. The closing motion drive of the throttle valve 33 is carried out by the throttle motor which is not illustrated, and the air content (inhalation air content) inhaled by the engine 10 through the inhalation-of-air path 30 by this is adjusted. This inhalation air content is detected by the air flow meter 32.

[0031] The three way component catalyst 51 which promotes oxidation of the unburnt component in exhaust gas (HC, CO) and reduction of nitrogen oxides (NOx) to coincidence is formed in the flueway 50 of an engine 10. Based on the residual oxygen density in exhaust gas, O2 sensor 52 by which a theoretical-air-fuel-ratio twist also detects Rich or Lean is formed in the upstream of this three way component catalyst 51 in the air-fuel ratio (A/F).

[0032] Moreover, the electronic control (ECU) 16 is carried in the hybrid car. From this ECU16, a control signal is outputted to inverters 40 and 41, respectively. Moreover, the signal outputted from various kinds of sensors is inputted into ECU16 besides the signal showing the inhalation air content detected by the air flow meter 32. As such a sensor, the throttle opening sensor 17, the intake-pressure sensor 18, the crank angle sensor 19, the speed sensor that is not illustrated, the accelerator opening sensor 39, and the knock sensor 49 grade are prepared. The throttle opening sensor 17 detects the opening (throttle opening) of a throttle valve 33 which adjusts an inhalation air content. The intake-pressure sensor 18 detects the intake pressure in the inhalation-of-air path 30.

[0033] the crank angle sensor 19 -- crankshaft 10a -- a predetermined include angle -- for example, a pulse signal is outputted whenever it rotates 30 degrees. In ECU16, an engine speed is computed from the pulse signal outputted from the crank angle sensor 19. A speed sensor detects the travel speed (vehicle speed) of a car. The accelerator opening sensor 39 detects the amount of treading in of an accelerator pedal (accelerator opening). And a knock sensor 49 detects knocking of an engine 10.

[0034] Based on the detecting signal of these various sensors, ECU16 carries out actuation control of an injector 36, the ignitor 37, etc., and performs fuel-injection control which controls injection quantity, fuel injection timing, etc. of the fuel injected from the stage (ignition timing) to perform ignition by the ignition plug 38, or an injector 36.

[0035] Moreover, ECU16 performs Air Fuel Ratio Control. In order to heighten oxidization / reduction capacity by the three way component catalyst 51, it is necessary to control an air-fuel ratio (A/F) for the fuel condition of an engine 10 near the theoretical air fuel ratio (window). However, by hybrid car like this example, as mentioned above, oxygen is stored in a catalyst by suspending an engine 10 intermittently, and there is a property that NOx in exhaust gas increases. Therefore, in this example, a target air-fuel ratio is set a little to a rich side from theoretical air fuel ratio, and Air Fuel Ratio Control which carries out feedback control of the fuel oil consumption based on the output of O2 sensor 52 is performed so that an engine air-fuel ratio may turn into a target air-fuel ratio.

[0036] Moreover, when charge of a dc-battery 42 is needed during a stop, ECU16 operates an engine 10 and makes a generator 11 drive for the charge. In this way, when carrying out load operation of the engine 10 during a stop, ECU16 brings near predetermined time and a target air-fuel ratio by the rich side from theoretical air fuel ratio from the time of initiation of this load operation, and performs Air Fuel Ratio Control.

[0037] ECU16 is equipped with memory 16a which carries out storage maintenance of the program

for performing these control, the map for an operation, the data computed on the occasion of activation of control. In addition, as mentioned above, by the hybrid car of this example, an engine 10 is usually automatically suspended at the time of a car stop. Moreover, even if it is under stop, when a dc-battery 42 needs to be charged, or when the air conditioner is driving, an engine 10 drives.

[0038] Next, the Air Fuel Ratio Control processing under stop which ECU16 performs is explained based on drawing 1 . ECU16 repeats the routine of the Air Fuel Ratio Control processing shown in drawing 1 a predetermined control period, and performs it.
[0039] First, at step S100, it judges whether the car has stopped or not. The vehicle speed with which this judgment is detected for example, with the above-mentioned speed sensor (illustration abbreviation) is judged as the car having stopped by "0", when a parking location or a shift lever is judged as a side brake lever being in P position. If judged with the car having not stopped, it will progress to step 110. At this step, counted value of the charge condition continuation counter ecchg is set to "0."
[0040] If judged with the car having stopped at step S100, it will progress to step S120. It is judged at this step S120 whether the dc-battery 42 is charged. It will be started if ECU16 detects charge of the dc-battery 42 under stop with the output of the dc-battery electrical-potential-difference sensor which does not illustrate that battery voltage fell to the predetermined lower limit, and the judgment result of step S120 is set to YES.
[0041] Charge of a dc-battery 42 is continued after the charge initiation until ECU16 detects that battery voltage rose to the predetermined upper limit with the output of a dc-battery electrical-potential-difference sensor. Therefore, after charge initiation of a dc-battery 42 is judged to be "under charge", and progresses to step 130 until battery voltage reaches a predetermined upper limit. On the other hand, detection of that battery voltage rose to the predetermined upper limit advances it to the above-mentioned step S110 after the charge initiation.
[0042] In addition, when the judgment result of step S120 is set to YES in the condition that the engine 10 has stopped during a stop, ECU16 outputs a control signal to an injector 36, an ignitor 37, etc., performs the above-mentioned fuel-injection control, and makes an engine 10 drive. By this, the power of an engine 10 is transmitted to a generator 11 through the power division device 13, a generation of electrical energy is performed by the generator 11, and a dc-battery 42 is charged by the power being supplied to a dc-battery 42.
[0043] On the other hand, also when the judgment result of step S120 is set to YES in the condition that idle operation of the engine 10 is carried out during the stop, the power of an engine 10 is transmitted to a generator 11, and the power generated with the generator 11 is supplied to a dc-battery 42, and is charged. If charge of a dc-battery 42 is started as mentioned above and the judgment result of step 120 is set to YES, the increment of the counted value of the charge initiation point in time to the charge condition continuation counter ecchg is carried out from "0."
[0044] If charge of a dc-battery 42 is started and it progresses to step 130, it will be judged whether the counted value of the charge condition continuation counter ecchg became beyond predetermined time (here A seconds). If it progresses to step S140 and the counted value becomes A seconds or more when the counted value is less than A seconds, it will progress to step 150.
[0045] At step S140, ECU16 is made to perform Air Fuel Ratio Control at the time of carrying out load operation of the engine 10 with the target air-fuel ratio brought near by the rich side from theoretical air fuel ratio, in order to charge a dc-battery 42 during a stop. That is, "rich ****" is permitted. In this way, in order to charge a dc-battery 42 during a stop, Air Fuel Ratio Control at the time of carrying out load operation of the engine 10 in a idle state or idle operational status is performed with the target air-fuel ratio brought near by the rich side.
[0046] Thereby, the amount of oxygen in a three way component catalyst 51 is changed to the side [exhaustion / side /, i.e. keep away from the generating conditions of NOx,]. For example, when many amounts of oxygen are stored as are shown in drawing 2 , and Signs a and b show in a three way component catalyst 51 at the charge initiation time (charge start), as the amount of oxygen shows as an alternate long and short dash line or a continuous line, it changes to the side [exhaustion / side /, i.e. keep away from the generating conditions of NOx,]. Thereby, NOx in exhaust gas comes to be reduced.

[0047] During such Air Fuel Ratio Control, if the predetermined time for A seconds passes since the time of charge initiation of a dc-battery 42, the judgment result of step S130 will be set to YES, and will progress at step S150. At this step S150, ("rich ****") is forbidden for performing Air Fuel Ratio Control with the target air-fuel ratio brought near by the rich side from theoretical air fuel ratio. He is trying for the amount of oxygen in the three way component catalyst 51 which was changing to the exhaustion side by this as the alternate long and short dash line or continuous line of drawing 2 showed not to change to an exhaustion side any more.
[0048] In this way, Air Fuel Ratio Control made into "rich ****" is performed until the predetermined time for A seconds passes since the time of charge initiation of a dc-battery 42. In case load operation of the engine 10 is carried out by this until battery voltage reaches a predetermined upper limit, the amount of oxygen in a three way component catalyst 51 is drained, and he is trying for a catalyst smell not to occur.
[0049] In addition, if Air Fuel Ratio Control is performed with the target air-fuel ratio brought near by the rich side at the time of charge initiation when there are few amounts of oxygen in a three way component catalyst 51 as the sign c of drawing 2 shows, the amount of oxygen will change, as the broken line of drawing 2 shows. In this case, that amount of oxygen is temporarily drained, and a catalyst smell generates it. When the predetermined time for A seconds has passed since the time of charge initiation, the drained amount of oxygen is again stored in the three way component catalyst 51, and a catalyst exhaust air smell stops however, occurring by forbidding "rich ****." And a catalyst exhaust air smell is that which is not what it generates and crew senses the smell immediate as (it is insensible), and even if a catalyst exhaust air smell occurs temporarily, there is especially no problem.
[0050] The processing shown in drawing 1 is once ended after activation of step 140. According to 1 operation gestalt constituted as mentioned above, the following operation effectiveness is done so.
(b) In order to charge a dc-battery 42 during a stop, when carrying out load operation of the engine 10, bring near a target air-fuel ratio by the rich side from theoretical air fuel ratio, and perform Air Fuel Ratio Control (step S140). This changes to the side [exhaustion /, i.e., keep away from the generating conditions of NOx, / in which / the amount of oxygen in a three way component catalyst 51], and NOx in exhaust gas is reduced. It can prevent that the oxygen in a three way component catalyst 51 is drained, and a catalyst exhaust air smell occurs with this because only the predetermined time for A seconds performs the Air Fuel Ratio Control from the time of charge initiation (at the time of initiation of load operation) (steps S130 and S150). Therefore, in case a dc-battery 42 is charged during a stop, Air Fuel Ratio Control with which reduction of NOx and generating prevention of a catalyst exhaust air smell are compatible can be performed.
[0051] (b) The operation effectiveness of the above-mentioned (b) becomes especially effective in a hybrid car with a small capacity of a Maine dc-battery like a dc-battery 42. That is, by the hybrid car with the small capacity, there is a disadvantageous factor, like the time amount rate depending on the engine in power which drives a car is long. So, by the hybrid car with a small capacity of the Maine dc-battery, there is an inclination to set a target air-fuel ratio to a rich side more, rather than a hybrid car with the large capacity. In this way, when Air Fuel Ratio Control is performed with the target air-fuel ratio brought near by the rich side too much, there is a possibility that the catalyst exhaust air smell in a three way component catalyst 51 may occur. In case the Maine dc-battery is charged during a stop by applying this invention to a hybrid car with a small capacity of such a dc-battery, reduction of NOx and Air Fuel Ratio Control which prevented generating prevention of a catalyst exhaust air smell effectively can be performed.
[0052] (c) If the predetermined time for A seconds passes since the time of charge initiation of a dc-battery 42, he is trying to forbid "rich ****" during Air Fuel Ratio Control which brought near the target air-fuel ratio by the rich side from theoretical air fuel ratio (step S150). By this, as the alternate long and short dash line or continuous line of drawing 2 shows, it is prevented that the amount of oxygen in the three way component catalyst 51 which was changing to the exhaustion side changes to an exhaustion side more than it, and it can prevent that a catalyst exhaust air smell occurs at the time of charge of a dc-battery 42. That is, the amount of oxygen in a three way component catalyst 51 is maintainable to the field from which it separated, respectively from the generating conditions of NOx, and the generating conditions of a catalyst exhaust air smell.

[0053] In addition, with the 1 above-mentioned operation gestalt, steps S130, S140, and S150 of drawing 1 are equivalent to the Air Fuel Ratio Control means.
Although 1 operation gestalt of this invention was explained beyond the [modification], the 1 above-mentioned operation gestalt can also change and carry out the configuration, as shown below.
[0054] - This invention is widely applicable to the hybrid car which has a different configuration not only from the hybrid car shown with the 1 above-mentioned operation gestalt but its car. In short, two sources of power, an engine 10 and a motor 12, and dc-battery 42 grade are carried, and this invention is widely applied to what carries out load operation of the engine, in order to charge a dc-battery during a stop.
[0055] - Although he is trying to set a target air-fuel ratio as a fixed value with the 1 above-mentioned operation gestalt in case a target air-fuel ratio is brought near by the rich side from theoretical air fuel ratio and Air Fuel Ratio Control is performed, this invention is not limited to this configuration. For example, you may make it bring near a target air-fuel ratio by the rich side more greatly, so that there are many amounts of oxygen in a three way component catalyst 51. By this configuration, the inclination which changes to a that amount's of oxygen exhaustion side becomes large, so that there are many amounts of oxygen within a catalyst. Thereby, even when there are many amounts of oxygen within a catalyst, the amount of oxygen can be early kept away from the generating conditions of NOx.
[0056] - Although only the predetermined time for A seconds is made to perform Air Fuel Ratio Control which brought near the target air-fuel ratio by the rich side from theoretical air fuel ratio from the time of charge initiation with the 1 above-mentioned operation gestalt, this invention is not limited to this configuration. For example, predetermined time is set as a larger value and it may be made to perform the Air Fuel Ratio Control, so that there are many amounts of oxygen in a three way component catalyst 51. By this configuration, even when there are many amounts of oxygen within a catalyst, that amount of oxygen can be early changed to the side [exhaustion / side /, i.e., keep away from the generating conditions of NOx,].
[0057] - Although a target air-fuel ratio is brought near by the rich side and it is made to perform Air Fuel Ratio Control with the 1 above-mentioned operation gestalt in case load operation of the engine 10 is carried out in order to charge a dc-battery 42 during a stop, this invention is not limited to this. For example, when performing load operation for driving an air conditioner during a stop, the same effectiveness as the case of charge is acquired by bringing near a target air-fuel ratio by the rich side from theoretical air fuel ratio, and performing Air Fuel Ratio Control.
[0058] - With the 1 above-mentioned operation gestalt, although O2 sensor 52 is formed only in the upstream of a three way component catalyst 51, O2 sensor is formed also in the downstream, and also when performing Air Fuel Ratio Control based on one [at least] output of both O2 sensor 52, this invention is applied.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The flow chart which shows Air Fuel Ratio Control under stop performed with 1 operation gestalt of this invention.
[Drawing 2] The explanatory view showing signs that the amount of oxygen within a catalyst changes with these Air Fuel Ratio Control.
[Drawing 3] The outline block diagram showing the engine and drive system of a hybrid car concerning 1 operation gestalt.
[Description of Notations]
10 [-- Dc-battery.] -- An engine, 12 -- A motor, 16 -- An electronic control (ECU), 42

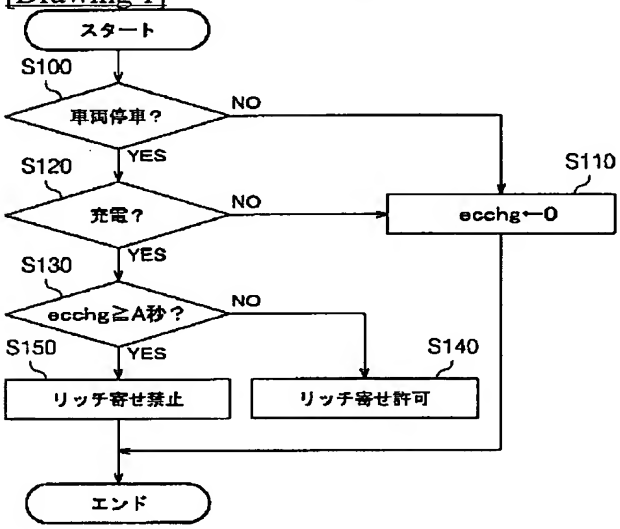
[Translation done.]

* NOTICES *

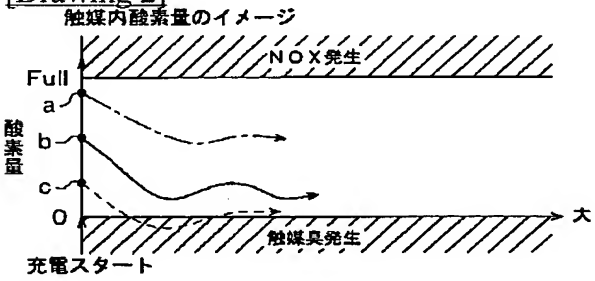
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

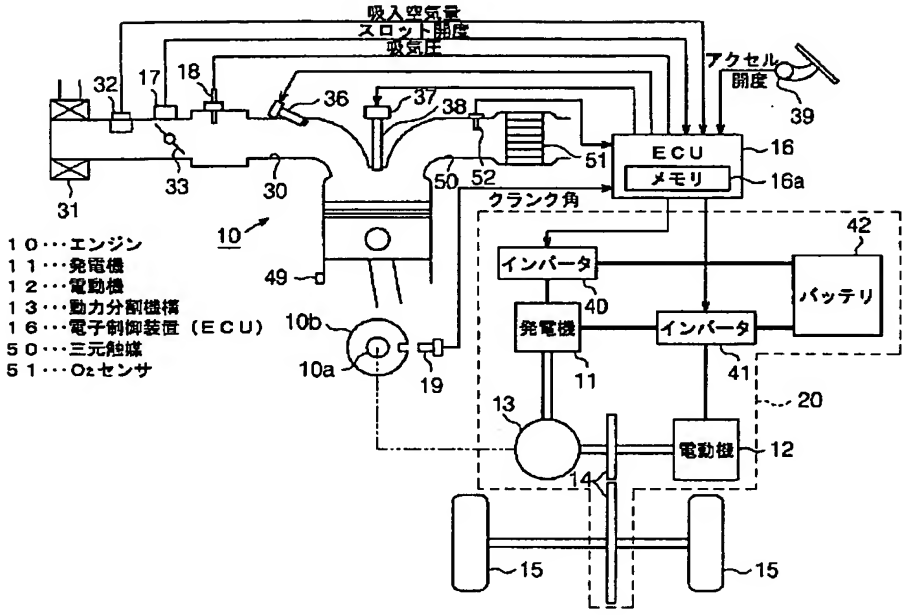
[Drawing 1]



[Drawing 2]



[Drawing 3]



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					Ｕ	3G301
Ｆ０２Ｄ	29/02		Ｆ０２Ｄ	29/02	Ｄ	
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審査請求　未請求　請求項の数６　ＯＬ　（全８頁）　最終頁に続く

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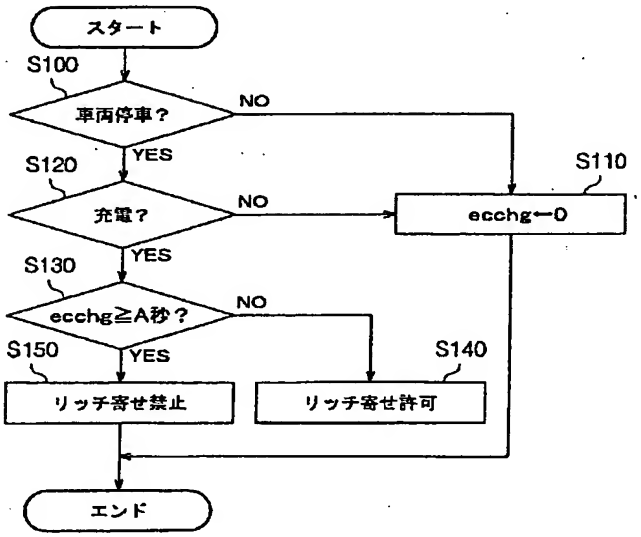
最終頁に続く

(54)【発明の名称】内燃機関の空燃比制御装置

(57)【要約】
【課題】　ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を可能にした内燃機関の空燃比制御装置を提供すること。
【解決手段】　停車中にバッテリを充電するためにエンジンを負荷運転するとき、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行うことにより（ステップＳ１４０）、三元触媒内の酸素量がＮＯｘの発生条件から遠ざかる側に変化し、排気ガス中のＮＯｘが低減される。これとともに、その空燃比制御を充電開始時からＡ秒の所定時間だけ行うことで（ステップＳ１３０，Ｓ１５０）、三元触媒内の酸素が枯渇して触媒排気臭が発生するのを防止できる。したがって、停車中にバッテリを充電する際に、ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を実現できる。



1

【特許請求の範囲】

【請求項１】　内燃機関及び電動機の２つの動力源と、同電動機に電力を供給するバッテリとを備えた内燃機関の空燃比制御装置において、

停車中に前記内燃機関を負荷運転するとき、同負荷運転の開始時から所定時間、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行う空燃比制御手段を備えることを特徴とする内燃機関の空燃比制御装置。

【請求項２】　前記空燃比制御手段は、停車中に前記バッテリを充電するために前記内燃機関を負荷運転するときに前記空燃比制御を行うことを特徴とする請求項１に記載の内燃機関の空燃比制御装置。

【請求項３】　前記空燃比制御手段は、触媒内の酸素量が多いほど前記目標空燃比をより大きくリッチ側に寄せた値に設定して前記空燃比制御を行うことを特徴とする請求項１又は２に記載の内燃機関の空燃比制御装置。

【請求項４】　前記空燃比制御手段は、触媒内の酸素量が多いほど前記所定時間をより大きい値に設定して前記空燃比制御を行うことを特徴とする請求項１又は２に記載の内燃機関の空燃比制御装置。

【請求項５】　前記空燃比制御手段は、前記停車中に停止状態にある前記内燃機関を駆動して負荷運転するときに前記空燃比制御を行うことを特徴とする請求項１～４のいずれか一項に記載の内燃機関の空燃比制御装置。

【請求項６】　前記空燃比制御手段は、停車中にアイドル運転状態にある前記内燃機関を負荷運転するときに前記空燃比制御を行うことを特徴とする請求項１～４のいずれか一項に記載の内燃機関の空燃比制御装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、内燃機関の空燃比制御装置、詳しくはハイブリッド車両の内燃機関の空燃比制御装置に関する。

【０００２】

【従来の技術】近年、内燃機関と電動機の２つの動力源が搭載され、走行状態等に応じてそれらの動力源を適宜切り換えるようにしたハイブリッド車両が提案されている。こうしたハイブリッド車両は、高速走行時には内燃機関により走行し、低速走行時で機関負荷が小さいとき（エアコンディショナの非駆動時等）には電動機によって走行する。また、低速走行時で機関負荷が大きいとき（エアコンディショナの駆動時等）には電動機と内燃機関によって走行する。また、停車時には通常内燃機関が自動的に停止されるが、停車中であってもバッテリの充電が必要な場合や、エアコンディショナが駆動されている場合には、内燃機関が駆動される。しかし、このような間欠的な機関停止により、排気通路に設けた触媒に酸素が蓄えられ、排気ガス中のＮＯｘが多くなってしまう。その対策として、目標空燃比を理論空燃比よりややリッチ側に設定し、機関空燃比が設定された目標空燃比

2

になるように、燃料噴射量をＯ２センサの出力に基づいてフィードバック制御するのが一般的な手法である。以下、この空燃比フィードバック制御を「空燃比制御」と略称する。

【０００３】

【発明が解決しようとする課題】ところで、上述したようにバッテリを充電するために、停車中に内燃機関により発電機を駆動すると、２０ｋｍ／ｈ走行時と同程度の負荷が内燃機関にかかることがある。このように停車中にバッテリ充電のために内燃機関を負荷運転する際の空燃比制御を、リッチ側に寄せ過ぎた目標空燃比で行うと、その背反として触媒内の酸素量が枯渇側に変化し、触媒排気臭が発生するおそれがある。これは、触媒内の酸素が飽和するとＮＯｘが発生し、逆に触媒内の酸素が枯渇すると触媒排気臭が発生するからである。こうして、排気ガス中のＮＯｘを規制値以下にするために、停車中における空燃比制御をリッチ側に寄せ過ぎた目標空燃比で行うと、ＮＯｘは少なくなる。しかしその背反として触媒排気臭が発生してしまう。なお、ＮＯｘは触媒内の酸素が飽和すると直ちに発生し、その飽和に対して敏感であるが、触媒排気臭は臭覚に頼る部分でもあり、その酸素が枯渇しても直ぐには検出されない（鈍感である）。

【０００４】また、従来技術として、触媒の下流側に設けたＯ２センサで触媒内の酸素量を検出し、この検出した酸素量に基づき空燃比制御をリッチ／リーンに制御するものが知られている。しかし、この従来技術では、上述したように内燃機関が間欠的に停止される場合、その停止前の条件によって触媒内の酸素量が異なる。この理由と、始動直後はその酸素量を正確に検出できないという理由とにより、ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を行うのが難しい。

【０００５】本発明は、このような従来の問題点に着目してなされたもので、その目的は、ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を可能にした内燃機関の空燃比制御装置を提供することにある。

【０００６】

【課題を解決するための手段】以下、上記目的を達成するための手段及びその作用効果について記載する。請求項１に係る発明は、内燃機関及び電動機の２つの動力源と、同電動機に電力を供給するバッテリとを備えた内燃機関の空燃比制御装置において、停車中に前記内燃機関を負荷運転するとき、同負荷運転の開始時から所定時間、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行う空燃比制御手段を備えることを要旨とする。

【０００７】この構成により、停車中に内燃機関を負荷運転するとき、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行うことにより、触媒内の酸素量が枯渇側、すなわちＮＯｘの発生条件から遠ざかる側に変

化するので、排気ガス中のＮＯｘが低減される。これとともに、その空燃比制御を負荷運転の開始時から所定時間だけ行うことで、触媒内の酸素が枯渇して触媒排気臭が発生するのを防止できる。したがって、ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を行うことができる。

【０００８】なお、ここにいう「負荷運転」には、停車中にバッテリを充電するのに発電機を駆動するための運転と、停車中にエアコンディショナを駆動するための運転とが含まれる。また、ここにいう「所定時間」は、触媒内の酸素量が枯渇して発生する触媒排気臭が乗員に不快感を与えないような時間に設定される。

【０００９】請求項２に係る発明は、請求項１に記載の内燃機関の空燃比制御装置において、前記空燃比制御手段は、停車中に前記バッテリを充電するために前記内燃機関を負荷運転するときに前記空燃比制御を行うことを要旨とする。

【００１０】この構成により、停車中にバッテリを充電するために内燃機関を負荷運転するときに、ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を行うことができる。

【００１１】請求項３に係る発明は、請求項１又は２に記載の内燃機関の空燃比制御装置において、前記空燃比制御手段は、触媒内の酸素量が多いほど前記目標空燃比をより大きくリッチ側に寄せた値に設定して前記空燃比制御を行うことを要旨とする。

【００１２】この構成により、触媒内の酸素量が多いほどその酸素量が枯渇側に変化する傾きが大きくなる。これにより、触媒内の酸素量が多い場合でも、その酸素量をＮＯｘの発生条件から早く遠ざけることができる。

【００１３】請求項４に係る発明は、請求項１又は２に記載の内燃機関の空燃比制御装置において、前記空燃比制御手段は、触媒内の酸素量が多いほど前記所定時間をより大きい値に設定して前記空燃比制御を行うことを要旨とする。

【００１４】この構成により、触媒内の酸素量が多いほど前記空燃比制御を行う所定時間をより長くするので、触媒内の酸素量が多い場合でも、その酸素量を枯渇側に、すなわちＮＯｘの発生条件から遠ざける側に早く変化させることができる。

【００１５】請求項５に係る発明は、請求項１～４のいずれか一項に記載の内燃機関の空燃比制御装置において、前記空燃比制御手段は、前記停車中に停止状態にある前記内燃機関を駆動して負荷運転するときに前記空燃比制御を行うことを要旨とする。

【００１６】この構成により、停車中にバッテリの充電が必要になり、停止状態にある内燃機関を駆動してその充電を行うときに、ＮＯｘの低減と触媒排気臭の発生防止が両立した最適な空燃比制御を実現できる。

【００１７】請求項６に係る発明は、請求項１～４のいずれか一項に記載の内燃機関の空燃比制御装置において、前記空燃比制御手段は、停車中にアイドル運転状態にある前記内燃機関を負荷運転するときに前記空燃比制御を行うことを要旨とする。

【００１８】この構成により、停車中にバッテリの充電が必要になり、アイドル運転状態にある内燃機関によりその充電を行うときに、ＮＯｘの低減と触媒排気臭の発生防止が両立した最適な空燃比制御を実現できる。

【００１９】

【発明の実施の形態】以下、本発明に係る内燃機関の空燃比制御装置をハイブリッド車両に適用した一実施形態を図面に基づいて説明する。

【００２０】図３は、ハイブリッド車両のエンジン（内燃機関）及び駆動系を概略的に示している。同図に示すハイブリッド車両には、エンジン１０及び電動機１２の２つの動力源と、同電動機１２に電力を供給するバッテリ（メインバッテリ）４２とが搭載されている。また、ハイブリッド車両には、エンジン１０の動力を駆動輪１５に伝える動力伝達系に設けられ、エンジン回転速度を無段階に変更可能な無段変速機構２０が搭載されている。

【００２１】この無段変速機構２０は、発電機能を有し発電した電力で電動機１２を駆動する発電機１１と、エンジン１０の発生する動力を、駆動輪１５を直接駆動する経路と、発電機１１を駆動して発電させる経路とに分割して伝達可能な動力分割機構１３とを備える。

【００２２】発電機１１にはインバータ４０が接続されており、同インバータ４０に入力される制御信号により、発電機１１をインバータ制御することにより、同発電機１１の回転速度を自由に変化させ得るようになっている。

【００２３】電動機１２にも、インバータ４１が接続されており、電動機１２をインバータ制御することにより、同電動機１２の回転速度を自由に変化させ得るようになっている。また、インバータ４１は発電機１１及びバッテリ４２に接続され、電動機１２は発電機１１で発電された電力及びバッテリ４２の電力の少なくとも一方で駆動可能である。

【００２４】なお、発電機１１は、車両の走行状態やバッテリ４２の残容量に応じて、エンジン１０の動力で駆動されて発電し、この電力でバッテリ４２を充電するようになっている。また、電動機１２も、減速時や制動時等に、発電機として機能して回生発電を行い、回収したエネルギーがバッテリ４２に蓄えられるようになっている。

【００２５】動力分割機構１３は、発電機１１に連結されたサンギア、電動機１２に連結されたリングギア、及びエンジン１０のクランクシャフト１０ａに連結されたプラネタリキャリアからなる遊星歯車で構成されている。そのプラネタリキャリアには、複数のプラネタリギ

アが回転可能に支持されており、各プラネタリギアは、サンギア及びリングギアの間にあって両ギアに噛合している。

【００２６】このように構成された無段変速機構２０では、エンジン１０の「始動時」には、駆動輪１５が止まっているため、リングギア（電動機１２、駆動輪１５）は停止されている。ここで発電機１１にバッテリ４２に蓄えられた電流を通電することでサンギアを回転させれば、エンジン１０が回転される。このとき、発電機１１は、スタータモータとして用いられている。

【００２７】「発進時」や「低速走行時」には、エンジン１０の作動を停止させて、電動機１２の動力のみによって駆動輪１５を駆動する。このとき発電機１１は、空転している。「通常走行時」には、エンジン１０が作動され、その動力が動力分割機構１３及び減速機１４を介して駆動輪１５に伝達される。また、エンジン１０の動力は、動力分割機構１３を介して発電機１１にも伝達され、同発電機１１にて発電が行われる。そして、発電機１１で発電した電力が電動機１２に供給され、同電動機１２が駆動されてエンジン１０の駆動力を補助する。また、全開加速時等の「高負荷時」には、電動機１２にバッテリ４２からの電力も供給される。

【００２８】このように、無段変速機構２０のインバータ４０，４１をＥＣＵ１６で制御して発電機１１の発電量や回転速度を調整することで、エンジン１０の回転速度を動力分割機構１３により適宜に調整可能になっている。すなわち、エンジン１０の作動効率が最大とするように両経路間の動力伝達の割合を適宜に変更できる。

【００２９】エンジン１０のクランクシャフト１０ａは、エアコンディショナ用のコンプレッサ（図示略）等の各種補機類にも駆動連結されており、エンジン１０の動力でそれら補機類が作動されるようになっている。

【００３０】エンジン１０の吸気通路３０には、その上流側から順に、エアクリーナ３１、エアフローメータ３２、スロットルバルブ３３が設けられている。スロットルバルブ３３は、図示しないスロットルモータで開閉駆動され、これにより吸気通路３０を通ってエンジン１０に吸入される空気量（吸入空気量）が調整される。この吸入空気量がエアフロメータ３２により検出される。

【００３１】エンジン１０の排気通路５０には、排気ガス中の未燃成分（ＨＣ，ＣＯ）の酸化と窒素酸化物（ＮＯｘ）の還元とを同時に推進する三元触媒５１が設けられている。この三元触媒５１の上流側には、排気ガス中の残留酸素濃度に基づき空燃比（Ａ／Ｆ）を理論空燃比よりもリッチかリーンかを検知するＯ２センサ５２が設けられている。

【００３２】また、ハイブリッド車両には、電子制御装置（ＥＣＵ）１６が搭載されている。このＥＣＵ１６から、インバータ４０，４１にそれぞれ制御信号が出力される。また、ＥＣＵ１６には、エアフロメータ３２により検出される吸入空気量を表す信号の他に、各種のセンサから出力される信号が入力される。こうしたセンサとして、スロットル開度センサ１７、吸気圧センサ１８、クランク角センサ１９、図示しない車速センサ、アクセル開度センサ３９、及びノックセンサ４９等が設けられている。スロットル開度センサ１７は、吸入空気量を調整するスロットルバルブ３３の開度（スロットル開度）を検出する。吸気圧センサ１８は、吸気通路３０内の吸気圧を検出する。

【００３３】クランク角センサ１９は、クランクシャフト１０ａが所定角度、例えば３０度回転する毎にパルス信号を出力する。ＥＣＵ１６では、クランク角センサ１９から出力されるパルス信号からエンジン回転速度を算出する。車速センサは、車両の走行速度（車速）を検知する。アクセル開度センサ３９は、アクセルペダルの踏み込み量（アクセル開度）を検出する。そして、ノックセンサ４９は、エンジン１０のノッキングを検出する。

【００３４】これら各種センサの検出信号に基づき、ＥＣＵ１６は、インジェクタ３６やイグナイタ３７などを作動制御して、点火プラグ３８による点火を行う時期（点火時期）やインジェクタ３６から噴射される燃料の噴射量や噴射時期などを制御する燃料噴射制御を実行する。

【００３５】また、ＥＣＵ１６は、空燃比制御を行う。三元触媒５１による酸化・還元能力を高めるためには、エンジン１０の燃料状態を空燃比（Ａ／Ｆ）を理論空燃比近傍（ウィンドウ）に制御する必要がある。しかし、本例のようなハイブリッド車両では、上述したようにエンジン１０が間欠的に停止されることにより、触媒に酸素が蓄えられ、排気ガス中のＮＯｘが多くなる特性がある。そのため、本例では、目標空燃比を理論空燃比よりややリッチ側に設定し、機関空燃比が目標空燃比になるように、燃料噴射量をＯ２センサ５２の出力に基づいてフィードバック制御する空燃比制御を実行する。

【００３６】また、ＥＣＵ１６は、停車中にバッテリ４２の充電が必要になった場合に、その充電のためにエンジン１０を運転して発電機１１を駆動させる。こうして停車中にエンジン１０を負荷運転するとき、ＥＣＵ１６は、同負荷運転の開始時から所定時間、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行うようになっている。

【００３７】ＥＣＵ１６は、これらの制御を実行するためのプログラムや演算用マップ、制御の実行に際して算出されるデータ等を記憶保持するメモリ１６ａを備えている。なお、上述したように、本例のハイブリッド車両では、車両停車時には、通常エンジン１０が自動的に停止されるようになっている。また、停車中であってもバッテリ４２の充電が必要な場合や、エアコンディショナが駆動されている場合には、エンジン１０が駆動されるようになっている。

【００３８】次に、ＥＣＵ１６の実行する停車中における空燃比制御処理を、図１に基づいて説明する。ＥＣＵ１６は、図１に示す空燃比制御処理のルーチンを、所定の制御周期で繰り返し実行する。

【００３９】まず、ステップＳ１００では、車両が停車しているか否かを判定する。この判定は、例えば上記車速センサ（図示略）で検出される車速が「０」でサイドブレーキレバーが駐車位置或いはシフトレバーがＰポジションにあると判定されたときに、車両が停車していると判定される。車両が停車していないと判定されるとステップ１１０に進む。このステップでは、充電状態継続カウンタｅｃｃｈｇのカウント値を「０」にする。

【００４０】ステップＳ１００で車両が停車していると判定されるとステップＳ１２０に進む。このステップＳ１２０では、バッテリ４２が充電されているか否かが判定される。停車中におけるバッテリ４２の充電は、バッテリ電圧が所定の下限値まで低下したことを図示しないバッテリ電圧センサの出力によりＥＣＵ１６が検出すると開始され、ステップＳ１２０の判定結果がＹＥＳになる。

【００４１】その充電開始後は、バッテリ電圧が所定の上限値まで上昇したことをバッテリ電圧センサの出力によりＥＣＵ１６が検出するまでバッテリ４２の充電が継続される。したがって、バッテリ４２の充電開始後は、バッテリ電圧が所定の上限値に達するまでは「充電中」と判定されてステップ１３０に進む。一方、その充電開始後、バッテリ電圧が所定の上限値まで上昇したことが検出されると、上記ステップＳ１１０に進む。

【００４２】なお、停車中にエンジン１０が停止している状態でステップＳ１２０の判定結果がＹＥＳになる場合、ＥＣＵ１６は、インジェクタ３６やイグナイタ３７などに制御信号を出力して上記燃料噴射制御を実行し、エンジン１０を駆動させる。これにより、エンジン１０の動力が動力分割機構１３を介して発電機１１に伝達され、発電機１１にて発電が行われ、その電力がバッテリ４２に供給されることで、バッテリ４２が充電される。

【００４３】一方、停車中にエンジン１０がアイドル運転されている状態でステップＳ１２０の判定結果がＹＥＳになる場合にも、エンジン１０の動力が発電機１１に伝達され、発電機１１で発電された電力がバッテリ４２に供給されて充電される。上述のようにバッテリ４２の充電が開始されてステップ１２０の判定結果がＹＥＳになると、その充電開始時点から、充電状態継続カウンタｅｃｃｈｇのカウント値が「０」からインクリメントされていく。

【００４４】バッテリ４２の充電が開始されてステップ１３０に進むと、充電状態継続カウンタｅｃｃｈｇのカウント値が所定時間（ここではＡ秒）以上になったか否かが判定される。そのカウント値がＡ秒未満の場合にはステップＳ１４０に進み、そのカウント値がＡ秒以上になるとステップ１５０に進む。

【００４５】ステップＳ１４０では、ＥＣＵ１６は、停車中にバッテリ４２を充電するためにエンジン１０を負荷運転する際の空燃比制御を、理論空燃比よりリッチ側に寄せた目標空燃比で行うようにする。つまり「リッチ寄せ」を許可する。こうして停車中にバッテリ４２を充電するために停止状態或いはアイドル運転状態にあるエンジン１０を負荷運転する際の空燃比制御を、リッチ側に寄せた目標空燃比で行う。

【００４６】これにより、三元触媒５１内の酸素量を枯渇側、すなわちＮＯｘの発生条件から遠ざける側に変化させる。例えば、図２に示すように、充電開始時点（充電スタート）で三元触媒５１内に符号ａ或いはｂで示すように酸素量が多く蓄えられている場合、その酸素量が一点鎖線或いは実線で示すように、枯渇側、すなわちＮＯｘの発生条件から遠ざかる側に変化していく。これにより、排気ガス中のＮＯｘが低減されるようになる。

【００４７】このような空燃比制御中に、バッテリ４２の充電開始時からＡ秒の所定時間が経過すると、ステップＳ１３０の判定結果がＹＥＳになり、ステップＳ１５０に進む。このステップＳ１５０では、空燃比制御を理論空燃比よりリッチ側に寄せた目標空燃比で行うのを（「リッチ寄せ」）を禁止する。これにより、図２の一点鎖線或いは実線で示すように枯渇側に変化していた三元触媒５１内の酸素量がそれ以上枯渇側に変化しないようにしている。

【００４８】こうして、「リッチ寄せ」にした空燃比制御をバッテリ４２の充電開始時からＡ秒の所定時間が経過するまで行う。これにより、バッテリ電圧が所定の上限値に達するまでエンジン１０を負荷運転する際に、三元触媒５１内の酸素量が枯渇して触媒臭が発生しないようにしている。

【００４９】なお、図２の符号ｃで示すように充電開始時に三元触媒５１内の酸素量が少ない場合、空燃比制御をリッチ側に寄せた目標空燃比で行うと、その酸素量は図２の破線で示すように変化する。この場合、その酸素量は一時的に枯渇し、触媒臭が発生する。しかし、充電開始時からＡ秒の所定時間が経過した時に「リッチ寄せ」を禁止することにより、枯渇した酸素量が三元触媒５１内に再び蓄えられていき、触媒排気臭が発生しなくなる。しかも、触媒排気臭は発生して乗員が即座にその臭いを感じるものではない（鈍感である）ので、触媒排気臭が一時的に発生しても特に問題はない。

【００５０】ステップ１４０の実行後、図１に示す処理は一旦終了する。以上のように構成された一実施形態によれば、以下の作用効果を奏する。

（イ）停車中にバッテリ４２を充電するためにエンジン１０を負荷運転するとき、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行う（ステップＳ１４０）。これにより、三元触媒５１内の酸素量が枯渇側、

すなわちＮＯｘの発生条件から遠ざかる側に変化し、排気ガス中のＮＯｘが低減される。これとともに、その空燃比制御を充電開始時（負荷運転の開始時）からＡ秒の所定時間だけ行うことで、三元触媒５１内の酸素が枯渇して触媒排気臭が発生するのを防止できる（ステップＳ１３０，Ｓ１５０）。したがって、停車中にバッテリ４２を充電する際に、ＮＯｘの低減と触媒排気臭の発生防止が両立する空燃比制御を行うことができる。

【００５１】（ロ）上記（イ）の作用効果は、バッテリ４２のようなメインバッテリの容量が小さいハイブリッド車両に特に有効になる。つまり、その容量が小さいハイブリッド車両では、車両を駆動する動力中エンジンに頼る時間割合が長い等の不利な要因がある。そこで、メインバッテリの容量が小さいハイブリッド車両では、その容量が大きいハイブリッド車両よりも、目標空燃比をよりリッチ側に設定する傾向がある。こうしてリッチ側に寄せ過ぎた目標空燃比で空燃比制御を行うと、三元触媒５１内の触媒排気臭が発生するおそれがある。このようなバッテリの容量が小さいハイブリッド車両に本発明を適用することにより、停車中にメインバッテリを充電する際に、ＮＯｘの低減と触媒排気臭の発生防止を効果的に防止した空燃比制御を行うことができる。

【００５２】（ハ）目標空燃比を理論空燃比よりリッチ側に寄せた空燃比制御中に、バッテリ４２の充電開始時からＡ秒の所定時間が経過すると、「リッチ寄せ」を禁止するようにしている（ステップＳ１５０）。これにより、図２の一点鎖線或いは実線で示すように枯渇側に変化していた三元触媒５１内の酸素量がそれ以上枯渇側に変化するのが防止され、バッテリ４２の充電時に触媒排気臭が発生するのを防止できる。つまり、三元触媒５１内の酸素量を、ＮＯｘの発生条件および触媒排気臭の発生条件からそれぞれ外れた領域に維持できる。

【００５３】なお、上記一実施形態では、図１のステップＳ１３０，Ｓ１４０及びＳ１５０が空燃比制御手段に相当する。

[変形例]以上、本発明の一実施形態について説明したが、上記一実施形態は以下に示すようにその構成を変更して実施することもできる。

【００５４】・本発明は、上記一実施形態で示すハイブリッド車両に限らず、その車両とは異なる構成を有するハイブリッド車両に広く適用可能である。要するに、本発明は、エンジン１０及び電動機１２の２つの動力源、バッテリ４２等が搭載され、停車中にバッテリを充電するためにエンジンを負荷運転するものに広く適用される。

【００５５】・上記一実施形態では、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行う際に、目標空燃比を一定の値に設定するようにしているが、本発明はこの構成に限定されない。例えば、三元触媒５１内の酸素量が多いほど目標空燃比をより大きくリッチ側に寄せるようにしてもよい。この構成により、触媒内の酸素量が多いほどその酸素量が枯渇側に変化する傾きが大きくなる。これにより、触媒内の酸素量が多い場合でも、その酸素量をＮＯｘの発生条件から早く遠ざけることができる。

【００５６】・上記一実施形態では、目標空燃比を理論空燃比よりリッチ側に寄せた空燃比制御を、充電開始時からＡ秒の所定時間だけ行うようにしているが、本発明はこの構成に限定されない。例えば、三元触媒５１内の酸素量が多いほど所定時間をより大きい値に設定してその空燃比制御を行なうようにしてもよい。この構成により、触媒内の酸素量が多い場合でも、その酸素量を枯渇側に、すなわちＮＯｘの発生条件から遠ざける側に早く変化させることができる。

【００５７】・上記一実施形態では、停車中にバッテリ４２を充電するためにエンジン１０を負荷運転する際に、目標空燃比をリッチ側に寄せて空燃比制御を行うようにしているが、本発明はこれに限定されない。例えば、停車中にエアコンディショナを駆動するための負荷運転を行う場合に、目標空燃比を理論空燃比よりリッチ側に寄せて空燃比制御を行うことにより、充電の場合と同様の効果が得られる。

【００５８】・上記一実施形態では、三元触媒５１の上流側にのみＯ２センサ５２を設けてあるが、その下流側にもＯ２センサを設け、両Ｏ２センサ５２の少なくとも一方の出力に基づいて空燃比制御を行う場合にも本発明は適用される。

【図面の簡単な説明】

【図１】　本発明の一実施形態で行う停車中における空燃比制御を示すフローチャート。

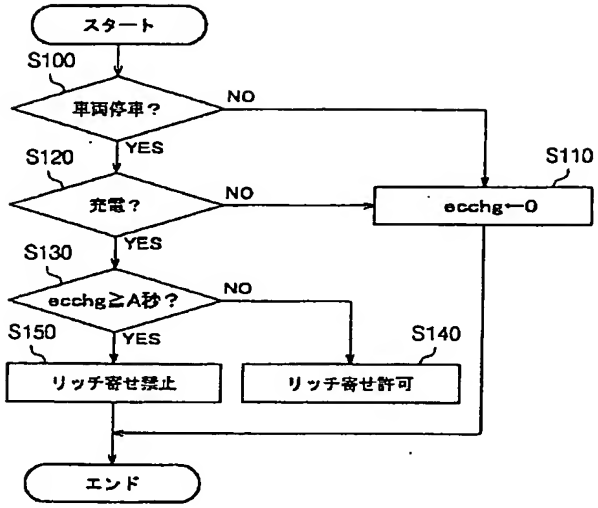
【図２】　同空燃比制御により触媒内の酸素量が変化する様子を示す説明図。

【図３】　一実施形態に係るハイブリッド車両のエンジン及び駆動系を示す概略構成図。

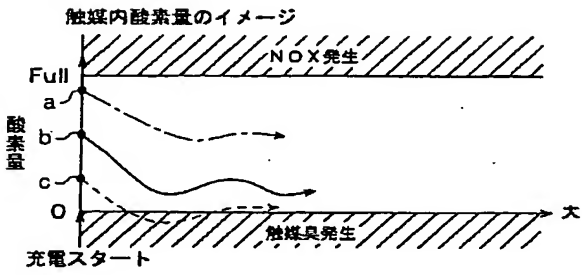
【符号の説明】

１０…エンジン、１２…電動機、１６…電子制御装置（ＥＣＵ）、４２…バッテリ。

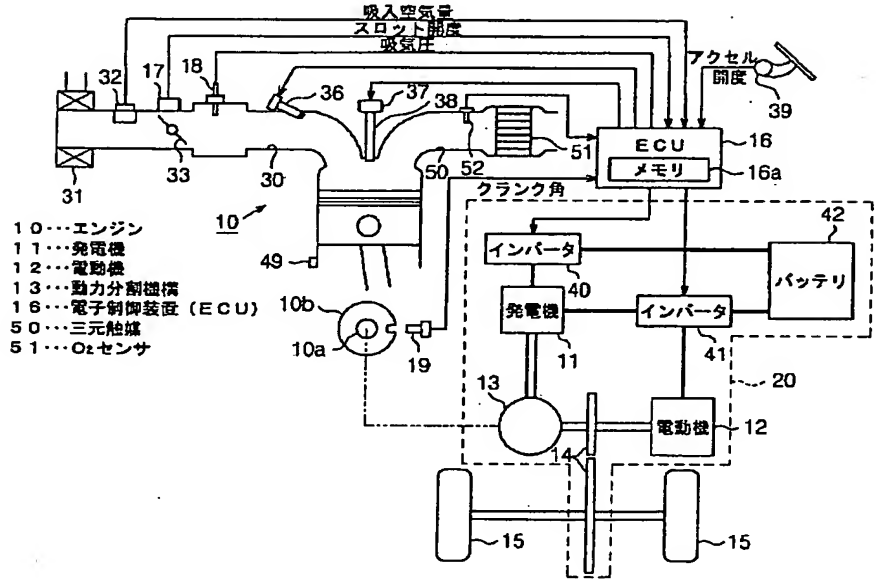
【図１】



【図２】



【図３】



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